



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/768,922	01/30/2004	Jun Hiraoka	02541D1/LH	7105
1933	7590	06/29/2005	EXAMINER	
FRISHAUF, HOLTZ, GOODMAN & CHICK, PC 220 5TH AVE FL 16 NEW YORK, NY 10001-7708			ECKERT II, GEORGE C	
			ART UNIT	PAPER NUMBER
			2815	

DATE MAILED: 06/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/768,922

Applicant(s)

HIRAOKA ET AL.

Examiner

George C. Eckert II

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 30 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-7 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☒ Certified copies of the priority documents have been received in Application No. 10/238362.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>1/30/04</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Specification*

1. The disclosure is objected to because of the following informalities: the first paragraph should be amended to refer to the parent application by serial number **and** its current status (i.e. now U.S. Patent 6,791,124). Appropriate correction is required.
2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,359,322 to Haralson et al. in view of applicant's admitted prior art. Haralson teaches in figure 2 and associated text an avalanche photodiode comprising:

an n-type semiconductor substrate 38; and

a plurality of layers formed above the substrate including:

an n-type light absorbing layer 34,

an n-type electric field relaxation layer 30/32 formed on an upper part of the n-type light absorbing layer,

Art Unit: 2815

a p-type electric field concentration layer 28 formed on the n-type electric field relaxation layer, and

a p-type multiplying layer 24 formed on an upper part of the p-type electric field concentration layer,

wherein the p-type electric field concentration layer 28 and the n-type electric field relaxation layer 30 form a pn junction (inherent as they abut each other),

wherein a carrier density of the n-type electric field relaxation layer 30 is larger than a carrier density of the p-type electric field concentration layer 28 (see col. 5, table 1 teaching that the carrier density of the n-type relaxation layer 30 “charge sheet” is  $2.9 \times 10^{17} \text{ cm}^{-3}$  and the carrier density of the p-type concentration layer “multiplication layer” is  $7 \times 10^{14} \text{ cm}^{-3}$ ), and

wherein when light is incident from the n-type substrate toward the light absorbing layer, electrons and holes are generated and holes are a main carrier (inherent based on the doping).

Haralson does not teach that the photodiode is configured as a sequential mesa type. Applicant's teach in their admitted prior art figures 9A and 9B such a sequential mesa configuration. Haralson and Applicant's prior art are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the device of Haralson in a sequential mesa configuration. The motivation for doing so, as is taught by the prior art, is that such configuration provides a higher speed APD (spec. page 4, lines 3-4). Furthermore, the higher value of current is a characteristic necessarily inherent in the device made obvious by Haralson and the admitted art. Therefore, it would have been obvious to combine Haralson and the admitted art to obtain the invention of claims 1-7.

Regarding claim 2, Haralson teaches a buffer layer 36 formed above the substrate and under the light absorbing layer 34. Regarding claim 3, Haralson teaches the light absorbing layer 34 is n- type InGaAs (col. 5, lines 3-4). Regarding claims 4 and 5, Haralson teaches a p+ type contact layer 22 formed on the p-type multiplying layer and it is considered well known in the art to use InGaAs as such a contact in place of InP. Regarding claims 6 and 7, Haralson teaches the substrate is n+ InP as well as the additional types and concentrations of the various layers (col. 4, line 65 to col. 5, line 35).

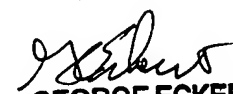
### *Conclusion*

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additional art is cited for teaching APDs similar to that instantly claimed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George C. Eckert II whose telephone number is (571) 272-1728.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
**GEORGE ECKERT**  
**PRIMARY EXAMINER**